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ARC TRACK RESISTANT POLYMERS FOR SPACE APPLICATIONS

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TRITON SYSTEMS, INC.

Develops Materials & Process Technologies in:

- **Specialty Materials - Advanced Polymers, Ceramics & MMC's**
- **Scratch Resistant/Antireflective Coatings**
- **Lasers Media - Biomedical Applications**

and Pursues Technology Transfer Through:

- **Joint Development**
- **Licensing**
- **Joint Ventures**

TRITON'S MISSION FOR NASA

**ECONOMICALLY COMMERCIALIZE
AORIMIDE POLYMERS FOR
SPACE, ELECTRICAL AND ELECTRONIC
APPLICATIONS**

New Electrical Insulation Materials Requirements

- **Easily Processed**
- **Amenable to Scale Up**
- **Arc Track Resistant**
- **Atomic Oxygen Resistant**
- **Light Weight**

AORIMIDE * (PAEBI) Is

- **Highly Processible**
- **Can Be Applied as Varnish or Tape**
- **Exceptionally Resistant to Atomic Oxygen**
- **Light Weight (ρ 1.2 g/cc vs 2.1 for Teflon)**
- **Is Exceptionally Arc Track Resistant**

* AORIMIDE is a tradename of a product manufactured by Triton Systems, Inc. Tradenames or manufacturers' names are used in this report for identification only. This usage does not constitute an official endorsement, either expressed or implied, by the National Aeronautics and Space Administration.

PROPERTIES	KAPTON *	FEP TEFLON *	AORIMIDE	Test Method
Tensile strength (ksi) MPa	10 - 25 ¹ 70 - 170	2.7 - 3.1 ² 18 - 21	19-23 ⁶ , 20.2 ⁷ 130-160, 139	ASTM D-882
Tensile modulus (ksi) GPa	290 - 450 ¹ 2.0 - 3.1	50 ² 0.34	556 ⁶ , 611 ⁷ 3.83, 4.21	ASTM D-882
Initial tear strength g / μ m	20.0 ¹		13.6 ⁷	ASTM-1004 (JIS C-2318)
Propagated Tear strength g/ μ m	0.47 ³			ASTM-1922 (JIS C-2318)
Elongation at break %	70 ¹	250 - 330 ²	17.8 ⁶ , 16.5 ⁷	ASTM D-882
T _g °C.	350-380	275 (T _m) ²	350 - 375	
CTE	30 - 60 ppm ¹	53-108 ppm ⁴	20 - 30 ppm	ASTM D-696
Thermal conductivity @ 23 C W/m K	0.10 - 0.35 ¹	0.25 ²		ASTM C-177 or ASTM F-433
Dielectric constant @ 1MHz	3.4 ¹	2.10 ⁴	2.95 ⁸	ASTM D-150
Dielectric strength @ 25 μ m thick	7000 v/mil (280 kv/mm) ¹	500 - 600 v/mil ² (1/8 " thick)	7000 v/mil ⁷	ASTM D149 (JIS C-2318)
Dissipation Factor @ 1MHz	0.010 ¹	0.0003 ⁴	0.0199 ⁸	ASTM D-150
Surface resistivity Ω	1 x 10 ¹⁶ ¹		> 1.0 x 10 ¹⁵ ⁸	ASTM D-257
Volume Resistivity Ω -cm	1 x 10 ¹⁸ ¹	> 2 x 10 ¹⁸ ⁴	> 3.1 x 10 ¹⁵ ⁸	ASTM D-257
Moisture absorption 24 hrs	0.2 - 2.9 % ¹	< .01 % ²	2.11% ⁷	ASTM D -570
Density (g/cc)	1.42	2.2	1.35	ASTM D-792
A/O resistance	low	good	EXCEPTIONAL	
Resistance to Ultra violet	good ¹	good	EXCELLENT	
Optical	Transparent (brown)	Transparent (clear)	Transparent (yellow)	

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APPROACH

DEVELOP THE INFRASTRUCTURE TO SUPPORT:

- Synthesis of the Polymer
- Processing into Useful Structures
- Identify End Applications
- Identify Performance Criteria
- Develop Prototypes
- Characterize Performance
- Provide Prototype Parts to End-Users
- Commercialize

Conclusions on AO Tests on TOR & AORIMIDE Los Alamos, 1993 , and MSFC, 1994

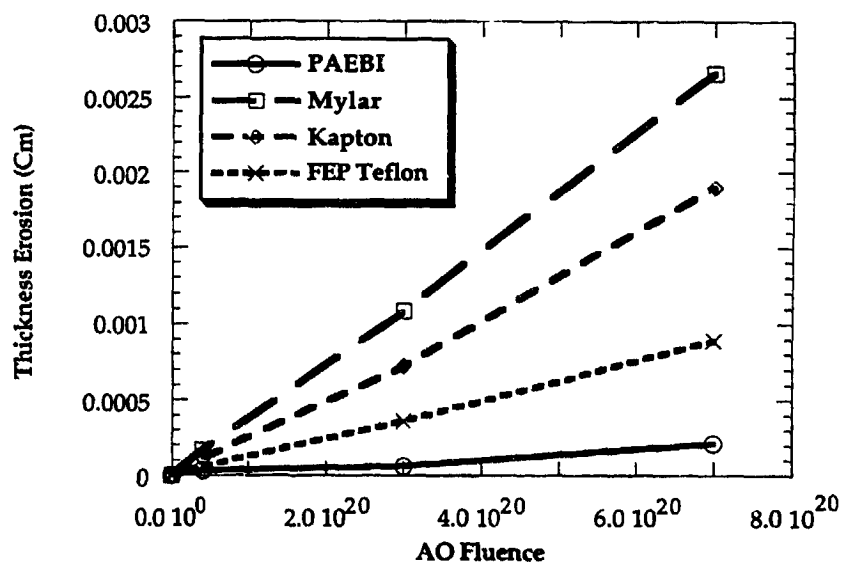
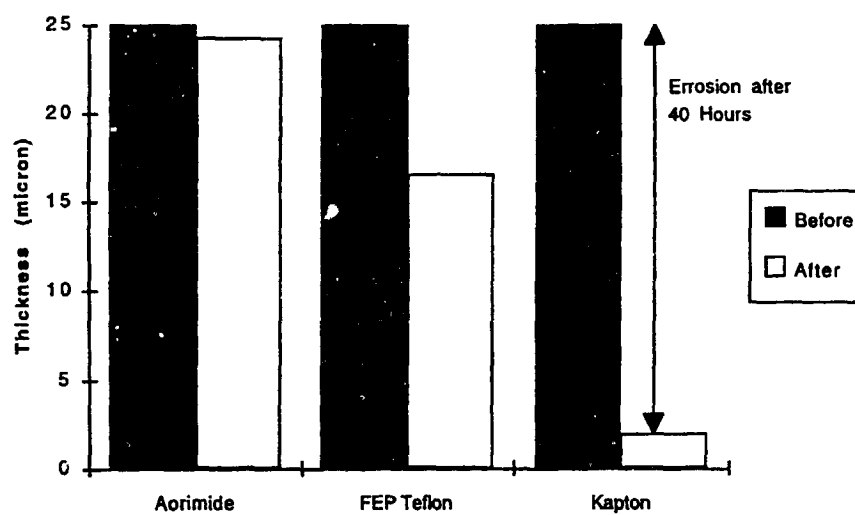
- Fast AO testing at 10^{21} AO/cm²

Aorimide 20 X more AO Resistant than Kapton
Aorimide 3 X more AO Resistant than Teflon

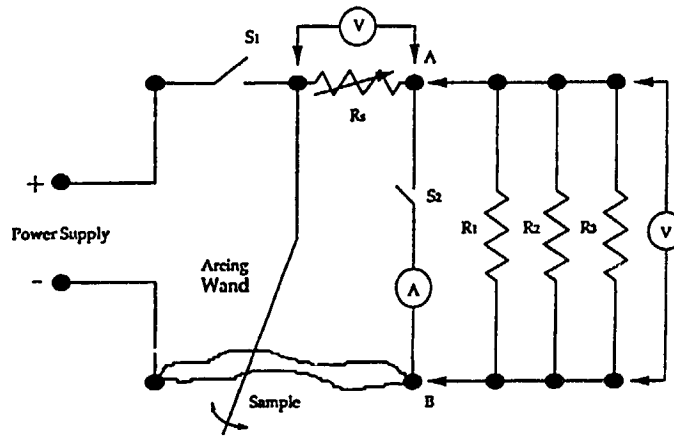
- Slow Asher Testing at 1.4×10^{21} AOcm²

Aorimide > 5 X more AO Resistant than Kapton
Aorimide not tested versus Teflon

Comparison Of Atomic Oxygen Resistance



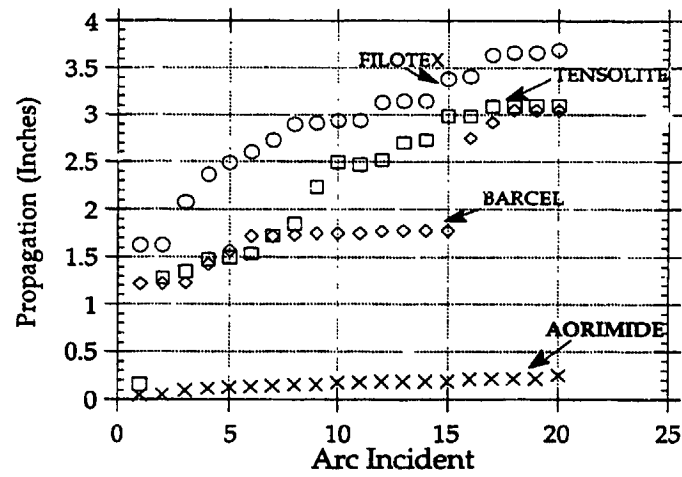
Arc Track Resistance Set-Up

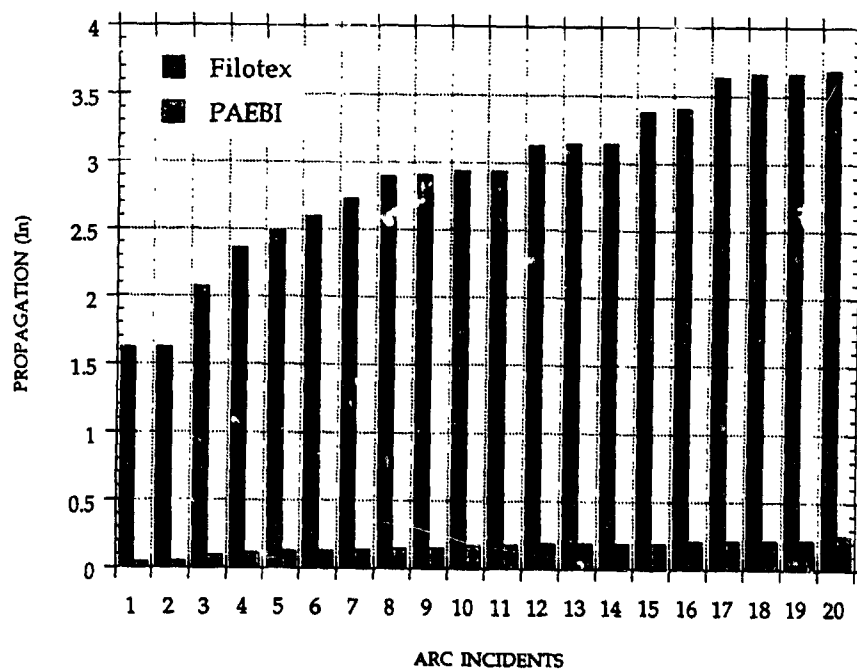
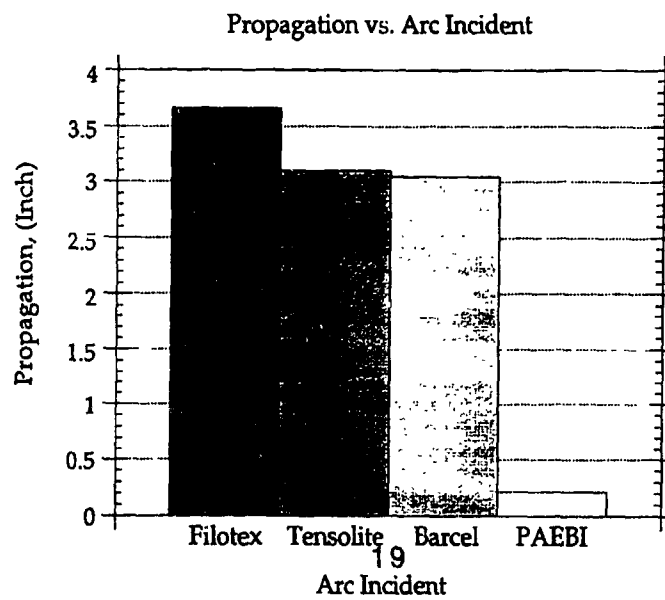


R_s : Series Resistor, 100 Ω , 225W

R_1, R_2, R_3 : 1000 Ω , 225W

Power Supply: 0 - 200 VDC, 0 - 17 A, 1000W

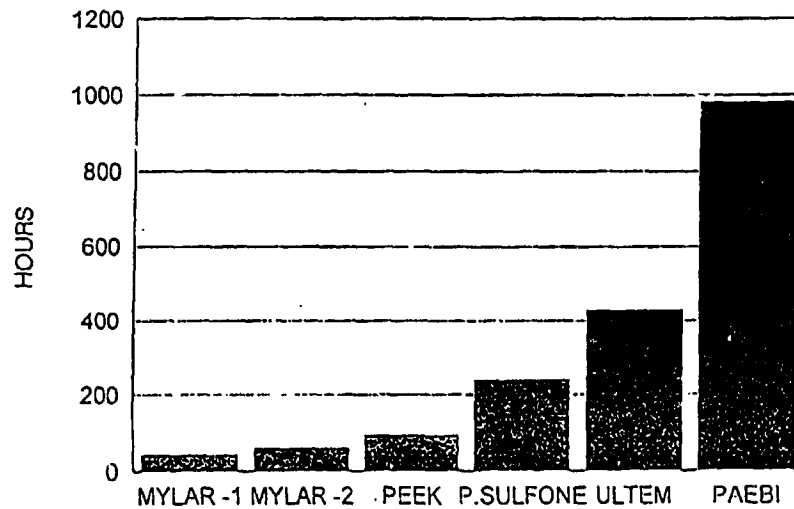




AORIMIDE - The Most Corona Resistant Unfilled Polymer

VOLTAGE ENDURANCE

412 HZ, 3 KV, 1/4" ELCTRS, 10 MIL FILMS



TIME FOR 5TH FAILURE OF 9 POINTS

UPCOMING ACTIVITIES

- **Optimize Wire Coating Application**
- **Verify Test Performance**
- **Coordinate with NASA Missions**
- **Develop Prototypes**
- **Space- Qualify**